JOURNAL

OF THE

Elisha Mitchell Scientific Society,

1889

SIXTH YEAR. PART ONE.

JOURNAL

OF THE

ELISHA MITCHELL SCIENTIFIC SOCIETY,

VOLUME VI—PART I.

JANUARY—JUNE.

1889.

PERMANENT SECRETARY:

F. P. VENABLE, . CHAPEL HILL, N. C.

E. M. UZZELL, STEAM PRINTER AND BINDER.
RALEIGH, N. C.
1889.

OFFICERS.

1889–1890.

PRESIDENT:

H. T. Bahnson, M. D., ... Salem, N. C.

VICE-PRESIDENT:

H. B. Battle, Ph. D., ... Raleigh, N. C.

RESIDENT VICE-PRESIDENT:

J. A. Holmes, B. Agr., ... Chapel Hill, N. C.

PERMANENT SECRETARY AND TREASURER:

F. P. Venable, Ph. D., F. C. S., ... Chapel Hill, N. C.

RECORDING SECRETARY AND LIBRARIAN:

J. W. Gore, C. E., ... Chapel Hill, N. C.

LIBRARY AND PLACE OF MEETING:

CHAPEL HILL, N. C.

TABLE OF CONTENTS.

PAGE.

List of Officers 2

Historical Notes Concerning the North Carolina Geological Survey. Prof. J. A. Holmes 5

Turpentine and Rosin. Dr. W. B. Phillips 19

The Creosoting of Wood with Wood Creosote Oil. I. H. Manning 27

Botany as a Disciplinary Study. Gerald McCarthy 33

Records of Meetings 38

JOURNAL

OF THE

Elisha Mitchell Scientific Society.

HISTORICAL NOTES CONCERNING THE NORTH CAROLINA GEOLOGICAL SURVEYS.*

J. A. HOLMES.

There are three North Carolina State surveys that have been called geological surveys: (1) the "Geological and Mineralogical Survey," conducted by Professors Denison Olmsted and Elisha Mitchell (1824–'28), here termed the Olmsted-Mitchell survey; (2) the "Geological, Mineralogical, Botanical and Agricultural Survey," prosecuted under Professor Ebenezer Emmons (1852–'61 or '64), here called the Emmons survey; and (3) the "Geological, Mineralogical, Botanical and Agricultural Survey," prosecuted under Professor W. C. Kerr (1866–'85), here termed the Kerr survey. The last mentioned of these may be considered as in part a continuation of the second.

Olmsted-Mitchell Survey, 1824—1828.*

This "Geological and Mineralogical Survey" was proposed by Professor Olmsted in a letter laid before the State Board of Internal Improvements of North Carolina, December 1st, 1821. (Preserved in the Executive office, Raleigh). The Board approved, and presented the matter to the Legislature. The

*Abstracted from a more elaborate sketch prepared by the writer for the U. S. Geological Survey, and published by permission of the Director.

Legislature took no action in the matter, however, until two years later, when the proposition was renewed. The survey was authorized by act of the General Assembly, ratified December 31st, 1823. This act made it the duty of the "Board of Agriculture of North Carolina to employ some person of competent skill and science to commence and carry on a geological and mineralogical survey of the various regions of this State."

Denison Olmsted (at that time Professor of Chemistry, Geology and Mineralogy in the University of N. C.) was appointed by the Board of Agriculture to make the survey, and prosecuted the work during the University vacations* of the years 1824 and 1825. In the latter part of 1825, Olmsted resigned (to accept a professorship at Yale College), and was succeeded by Elisha Mitchell, both in the professorship in the University and as geologist of the survey. The work of the survey was prosecuted by Professor Mitchell during the University vacations, beginning late in 1825 and continuing through 1828. The only assistant employed in the work of the survey was Charles E. Rothe, a "miner and mineralogist from Saxony," engaged for a short time by Professor Olmsted in 1825 to make an examination of portions of the "great slaty formation" (Huronian of Kerr) which crosses the State.

The general purposes of the survey appear to have been, on the part of Professor Olmsted (who proposed it) and Professor Mitchell, the opportunity to become acquainted with the geology and mineralogy of the State, and to procure specimens of rocks and minerals illustrative of the same, and, on the part of the State, the discovery of mineral deposits of value within the State, and the publication of reports, in which these deposits should be described and the value and uses of the minerals made known to the people.

The survey was sustained by an annual appropriation of two hundred and fifty dollars ($250), continued for five years. This amount was each year paid over to the geologist, and out of it

*Amounting to six weeks during the summer and four weeks during the winter.

he bore all expenses of the survey, exclusive of publication. The geologist's regular salary as professor in the University ($1,240) was continued during his connection with the survey.

Small collections of rocks and minerals were made by both Olmsted and Mitchell and deposited at the State University; but these have disappeared.

As to results: The survey is now of interest mainly from an historic stand-point as being the earliest of the American State surveys. It must be considered as little more than a rough geological reconnoisance of the State, during which special attention was given to minerals of economic importance. And when one considers the condition of geological science at the time the survey was made, the lack of experience in making geological surveys, the limited time and fund at the disposal of the geologists, but little more can be expected. Both Olmsted and Mitchell did work of permanent value in locating and describing briefly the geological formations of the middle and eastern sections of the State.

The publications of the survey consisted of four small annual reports, each published as a part of a small volume of reports, essays, etc., and distributed free, under the direction of the State Board of Agriculture. The number of copies of each annual report published was fifteen hundred.

BIBLIOGRAPHY:

Report on the Geology of North Carolina, Part I; by Denison Olmsted. Raleigh, 1824, 12 mo., 41 pp.

Report on the Geology of North Carolina, Part II; by Denison Olmsted. Raleigh, 1825, 12 mo., 58 pp.

Report on the Geology of North Carolina, Part III; by Elisha Mitchell. To which is added a paper on Gold Mines of North Carolina, by C. E. Rothe, reprinted from Silliman's Journal for 1825. Raleigh, 1827, 12 mo., 43 pp.

Geological Report of Professor Mitchell. 1829, 12 mo., 8 pp.

After the discontinuance of the Olmsted-Mitchell survey (1828) Professor Mitchell for several years continued to make

geological explorations through different portions of the State, at his own expense. The general results of these explorations he published, in 1842, in a small text-book (Elements of Geology, with an outline of the Geology of North Carolina; for the use of the students of the University. 1842, 12 mo., 141 pp., with a geological map of North Carolina).

No further organized State work in geology was undertaken until 1852.

Emmons Survey, 1852—1864.

The act authorizing this survey was passed by the General Assembly at its session of 1850–'51, and ratified January 24th, 1851. This act, under which the survey was organized and conducted, specified that the Governor should appoint some suitable person to make a "Geological, Mineralogical, Botanical and Agricultural survey of the State," and to prepare for publication reports embodying the results of his investigations, and, when practicable, to deliver lectures on these subjects in the villages of the State. The geologist was to appoint, subject to the approval of the Governor, such assistants as were necessary.

The survey was sustained by an annual appropriation of five thousand dollars ($5,000), authorized by the act establishing the survey, to be paid upon the warrant of the Governor, out of the State Treasury. This was expended under the direction of the geologist, mainly, in payment of salaries. The geologist and assistants bore the ordinary expenses of the survey. Publication was paid for out of the State Treasury.

Professor Emmons was appointed geologist by Governor Reid, October 8th, 1851. The work of the survey was begun in January, 1852, and continued until the breaking out of the Civil War, in 1861. Nominally the survey was continued until April, 1864; but during the war the geologist and assistant were engaged in procuring and manufacturing munitions of war and economic mineral products needed by the people of the State. Professor Emmons died October 1st, 1863, and the assistant geologist, Ebenezer Emmons, Jr., resigned April, 1864, which latter date marks the conclusion of the Emmons survey.

The *general purpose* of the survey was the investigation of the geology, natural history and natural resources of the State. But among these, the object which stood out more prominently and was more influential in leading to the establishment and maintenance of the survey, was the development of the mineral, mining and agricultural interests of the State.

As to the *methods of operation* adopted by the survey, only general statements can be made. The larger part of the work of the survey, in the field, office and chemical laboratory, was done by Professor Emmons and E. Emmons, Jr. Professor Emmons was the geologist, chemist, mineralogist, paleontologist and agriculturist of the survey. The assistants employed, except in the case of Dr. Curtis, were general assistants rather than specialists.

The work of the survey was mainly in connection with the general geology, mining, agriculture and paleontology. In the field work these were given prominence according to their relative importance in the regions being examined. In topography, practically nothing was attempted. In botany and zoölogy, Dr. Curtis' work appears to have consisted mainly of the writing up for publication the results of his observations previously made.

In general geology, the formations east of the Blue Ridge appear to have been examined with considerable care, as to outlines, lithological and stratigraphical characteristics, and fossil remains (where these occur). Many results of these examinations were published in the reports for 1856 and 1858, but many of them were lost in the form of MSS. or field notes. In the region west of the Blue Ridge only a partial reconnoisance appears to have been made, the results of which were nearly all lost in the form of MSS. or field notes. In paleontology, a number of both vertebrate and invertebrate fossil remains were discovered and described from the eocene, miocene and cretaceous marl pits and river bluffs of the eastern region; as were also the remains of several interesting species of vertebrates, and a rich fossil flora from the Deep and Dan River coal fields of the older mesozoic. (See Emmons' N. C. Reports for 1856 and 1858,

American Geology, etc.). In mining, the principal then known, mineral properties of the State, were examined, drawings made of the veins and works, and, in many cases, analyses made of the ores. Of the results of these examinations, only a part was published; others were lost during the war. In agriculture, observations were made concerning the soils, their composition, products, and, through the reports of the survey, information was given as to methods of improving soils, etc.

The chemical work included analyses of soils, farm products, ores, minerals, rocks, mineral waters, etc. A room in Professor Emmons' private house, fitted up for the purpose, constituted the laboratory.

Among the *additions to science* made by the survey may be mentioned: (1) the rich flora of the Deep River coal fields (mesozoic), where were found about forty species, nine of which appear to be peculiar to North Carolina; (2) four new species of fossil fish and batrachians, eight species of reptiles and four of mammals, including the interesting insectiverous mammal, Dromotherium sylvestre, in the older mesozoic of Chatham county, and a few species of molluses.

The cabinet of the survey, located in the capitol building at Raleigh, contained a considerable number of specimens of rocks, minerals, ores, fossil plant and animal remains, soils, marls, etc., and was said to be one of considerable value. At the close of the Civil War (1865) it was nearly destroyed by soldiers passing through the city. The remnant was transferred to the State University, where it is at present.

PERSONNEL OF THE SURVEY:

Professor Ebenezer Emmons, M. D., Geologist, in charge of the Survey, 1851–'63, appointed by Governor Reid, October 8th, 1851, began work January, 1852, and continued in charge of the survey up to the date of his death, October 1st, 1863.

Ebenezer Emmons, Jr., assistant geologist, 1852–'64, was general assistant in the field, laboratory and office work.

Spence McClenahan, assistant geologist, 1852–'54, was engaged mainly in making a geological and topographical survey of the Deep River coal field and adjacent sandstone region.

Matthew B. Conklin, assistant geologist, April 1st, 1858—March 31st, 1860, was engaged mainly in collecting fossils and other specimens.

C. D. Smith, assistant geologist, 1859, engaged during a few months in making a geological reconnoissance of the extreme western region of the State.

Moses A. Curtis, D. D., botanist and zoölogist, 1860–'62, was employed to prepare for publication by the survey reports on the botany and zoölogy of the State.

BIBLIOGRAPHY:

Report of Professor Emmons on his Geological Survey of North Carolina. Raleigh, 1852, 12 mo., 181 pp. Five thousand copies published.

Report on the Progress and Present State of the Geological and Agricultural Survey of North Carolina; by Ebenezer Emmons. Raleigh, 1855, 12 mo., 20 pp.

Geological Report of the Midland Counties of North Carolina; by Ebenezer Emmons. New York and Raleigh, 1856, 8 mo., XX, and 351 pp., 9 plates, 7 maps and sections. One thousand copies published.

National Foundry—Deep River, North Carolina. Special Report of Dr. E. Emmons, Geologist to the State of North Carolina, concerning the Advantages of the Valley of the Deep River as a Site for the Establishment of a National Foundry. Raleigh, 1857, 8 vo., 14 pp.

Report of the North Carolina Geological Survey. Agriculture of the Eastern Counties, together with Descriptions of the Fossils of the Marl Beds; by Ebenezer Emmons. Raleigh, 1858, 8 vo., XVI, and 314 pp. Two thousand copies published.

Agriculture of North Carolina, Part II; containing statement of the principles of the science upon which the practices of agriculture as an art are founded; by Ebenezer Emmons, State Geologist. Raleigh, 1860, 8 vo., 112 pp.

North Carolina Geological Survey, Part II; Agriculture. Containing descriptions, with many analyses, of the Soils of the Swamp Lands; by Ebenezer Emmons, State Geologist. Raleigh, 1860, 8 vo., 95 pp.

Geological and Natural History Survey of North Carolina, Part III; Botany. Containing descriptions and history of the Trees, Shrubs and Woody Vines; by Rev. M. A. Curtis, D. D. Raleigh, 1860, 8 vo., 123 pp.

Legislative Doc. No. 25. Appendix B. Gen. Assem., Sess. 1860–'61. A Report on the Natural Resources of that Part of North Carolina west of the Blue Ridge; by Ebenezer Emmons. Raleigh, 12 mo., 3 pp.

Document No. 26. Gen. Assem., Sess. 1860–'61. Geological and Agricultural Survey. A Report of Progress; by Ebenezer Emmons. Raleigh, 12 mo., 6 pp.

Agricultural, Geological and Descriptive Sketches of Lower North Carolina and the Similar Adjacent Lands; by Edmund Ruffin, of Virginia. Raleigh, 1861, 8 vo., 294 pp.

Geological and Natural History Survey of North Carolina, Part III. Botany; containing a catalogue of the Indigenous and Naturalized Plants of the State; by Rev. M. A. Curtis, D. D., F. A. A. A. S., etc., etc. Raleigh, 1867, 8 vo., 158 pp.

Unpublished Reports:—It appears that at the beginning of the Civil War there was on hand by Professor Emmons MSS. material for publication sufficient for one or more large octavo volumes relating especially to the agriculture, mining and mineral resources of the middle and western regions of the State; also in preparation a geological map of the State and a geological map of the Deep River coal fields, ready for publication; all of which appear to have been lost or destroyed during the war. There was also nearly or quite ready for publication reports by Dr. Curtis on the Quadrupeds and Reptiles and the Birds of North Carolina, neither of which has been published, nor can be found at present.

Kerr Survey.

The Kerr Survey was organized under the same law and with the same general functions as the Emmons Survey, of which it may be considered, in some respects, a continuation.

Professor Kerr was appointed State Geologist in 1864, and held the position nominally during the last year of the war, but no appropriation was made for the survey and no geological work was undertaken.

During the following year, 1865–'66, the survey does not appear to have had even a nominal existence. Professor Kerr was re-appointed April, 1866, the survey was reorganized, and its work resumed. In 1877, by legislative enactment, the geological survey, which formerly had existed as an independent organization, was made a co-operative department with the Department of Agriculture, and the State Chemist was made chemist *ex officio* to the survey; and in 1879 changes made in the law governing the survey brought the work of the latter still more under the control of the Department of Agriculture. The field work of the survey was practically discontinued in 1882, when Professor Kerr resigned to accept the position of Geologist on the United States Geological Survey, but was continued at intervals until his death in 1885.

The survey was sustained by an annual appropriation of $5,000, which covered all expenditures, including salaries, except that of publication.

The general *plan of operations* was an outgrowth of the great variety and extent of the work to be done, and the smallness of the appropriation, and as many of the results obtained by the Emmons survey having been lost during the war, others were out of date, and it was necessary that the work of the Kerr survey be extended over the entire State and investigations pursued with more modern methods. The general work of the survey was undertaken by Professor Kerr in person. In the several divisions of the work specialists and general assistants were engaged when needed. A list of these is given below under *personnel*.

In topography a considerable amount of work has been done by the survey, especially in the western portion of the State, since no topographical survey of that region had been made, and a more accurate map was needed as a base for the geological map. The necessary preliminary work was undertaken by the Geological Survey, and was carried on by Professor Kerr and his assistants at intervals, along with the field work in geology. Much of the topographical work was done somewhat hurriedly, but with as much detail and care as circumstances would permit, with the use of the pocket compass, pocket level, aneroid or mercurial barometers, pocket or marine sextant and chronometer (for obtaining latitude and longitude where necessary). A map of the State, embodying the results of many of these observations, together with data compiled from various other surveys, was published in 1882.

In general geology the work has been done by Professor Kerr in person. All the geological formations within the State have been examined, their outlines and general characters as to lithology, soils, topography, etc., noted. In this department, however, much detail work still remains to be done in all parts of the State.

In lithology the collections of crystalline and metamorphic rocks were submitted to Professor A. A. Julien (who has several times visited the region in person) for microscopic examination. His report is now in preparation.

In mineralogy the collections were in most of the cases submitted to Dr. F. A. Genth, whose reports are to be found in Kerr's Geology of North Carolina, Vol. I, 1875, Appendix C., and Vol. II, Chap. I, 1881.

In vertebrate and invertebrate paleontology the collections of the survey were submitted to Professors E. D. Cope and T. A. Conrad, respectively, both of whom, without remuneration, twice visited the State for the purpose of examining specimens and making collections. Their reports are to be found in Kerr's Geology of North Carolina, 1875, Appendix A.

In meteorology about thirty volunteer stations were established by the survey in different regions of the State, where observations have been taken with more or less regularity, as to the temperature, rain-fall, clouds, winds, and, in a few cases, atmospheric pressure and dew-points.

In chemistry the work included the analyses of soils, marls, minerals, the assay of ores, etc. From 1866 to 1877 the survey did not have adequate laboratory facilities, and specimens for analysis were mainly sent to the laboratory of specialists not connected with the survey. Subsequent to 1877 this work was done by the State Chemist, who was, by legislative enactment, *ex officio* chemist to the survey.

In agriculture the work done by the survey consisted in the analysis of soils, marls, fertilizers (prior to 1877), and the instruction of the people of the State, through the press and lectures by the geologist, as to the methods of improving soils.

In connection with the mining interests, the principal mining properties were examined by the geologist in person, and analyses or assays made of the ores were in many cases made under his direction.

The Museum of the survey, located in Raleigh, contains the following collections: Of minerals and ores, about six thousand specimens; rocks (hand specimens), about three thousand; building stones (a foot cube and less), about one hundred; soils and marls, nearly two hundred; fossil vertebrate remains, a small collection; fossil shells, several thousand specimens, including a large number of species from the cretaceous and tertiary deposits of the State; shells of living forms, land, fresh-water and marine, a small collection of each; native woods, upwards of two hundred specimens; small collections of Indian antiquities and agricultural products; and a few miscellaneous specimens, among which may be mentioned the skeleton of a whale (Balæna mysticetus) 65 feet in length.

The Library of the survey contains three hundred volumes, including treatises on geology, mineralogy, metallurgy, agriculture and general natural history, partial sets of the American

journals devoted to these subjects and reports of other State surveys. This library is supplemented by the much larger State Library in the adjacent capitol building.

PERSONNEL OF THE SURVEY:*

Professor W. C. Kerr, Director and Geologist, 1866—1882. His connection with the survey continued, irregularly, until his death, 1885.

Charles J. Curtis, assistant in topography, field work, during the summers of 1866 and 1868.

Professor N. A. Pratt, of Charleston (now of Atlanta), chemist, 1866—1867. Made a few chemical analyses of supposed phosphatic marl.

Captain William E. Cain, assistant in topography, at irregular intervals, from 1867 to 1882, in both field and office work.

Professor E. D. Cope, of Philadelphia, volunteer assistant in vertebrate paleontology, 1868–'69.

George B. Hanna, assistant in chemistry and assaying, at irregular intervals, 1869–'77, and mining in 1883.

Professor T. A. Conrad, of Philadelphia, volunteer assistant in invertebrate paleontology, 1870 and 1871.

George C. Jordan, special assistant, labeling and arranging cabinet collections, six months of 1870.

E. H. Bogardus, of the New Jersey Survey, special assistant in chemistry, making analyses of soils and marls, at intervals, 1870—1874.

Professor C. H. Chandler, of New York, made a few chemical analyses in 1871.

Dr. F. A. Genth, of Philadelphia, assistant in mineralogy, 1871 and 1880.

Mrs. C. P. Spencer, engaged mainly in coloring a geological map of the State during a short time of the winter of 1871–'72.

W. D. Cooke, special assistant, on geological map, tabulating data and other office work, at intervals, 1872–'76.

---

*Persons residents of North Carolina when it is not otherwise stated.

C. D. Smith, special assistant in geology and mineralogy for the region west of the Blue Ridge Mountains during portions of 1872, 1873 and 1874.

Professor Alexis A. Julien, of New York, lithologist, at intervals, 1875 to present date.

Dr. A. R. Ledoux, chemist *ex officio*, while State Chemist, 1877–'80.

T. C. Harris, curator of the museum and assistant in engraving and general office work, 1878 to present date.

A. G. Williamson, of Virginia, assistant in topography during a few autumn and winter months of 1879–'80.

R. G. Thomas, office assistant, tabulating meteorological data, December, 1880, to February, 1881.

C. W. Dabney, chemist *ex officio*, while State Chemist, 1880, to present date.

W. B. Phillips, assistant in geology, parts of 1881 and 1882, and acting State Geologist August, 1882, to February, 1883.

W. H. Kerr, field assistant in collection of building stones during a few months of 1882.

The names of meteorological observers connected with the survey are omitted for want of space.

BIBLIOGRAPHY:

Report of Progress of the Geological Survey of North Carolina, 1866; by W. C. Kerr, Raleigh, 1867, 8 vo., 56 pp. Number of copies published, 3,640.

Exec. Doc. No. 27, Sess. 1868–'69, Gen. Assem. of N. C.

Report of Progress of the Geological Survey; by W. C. Kerr. 1869, 57 pp.

Appendix to the Report of the Geological Survey of North Carolina, 1873, being a brief abstract of that report and a general description of the State, geographical, geological, climatic and agricultural; by W. C. Kerr. Raleigh, 1873, 8 vo., 24 pp. and map. Number of copies published 5,000.

Pub. Doc. No. 16, Sess. 1872–'73, Gen. Assem. of N. C. Report of Progress of the Geological Survey of North Carolina; by W. C. Kerr. 8 vo., 4 pp.

Report of the Geological Survey of North Carolina, Vol. I; Physical Geography, Resumé, Economic Geology; by W. C. Kerr. Raleigh, 1875, 8 vo., XVIII, 325 and 120 pp., 9 plates and a geological map. Number of copies published, 1,000.

Pub. Doc. No. 21, Sess. 1876–'77, Gen. Assem. of N. C. Report of the State Geologist on the Expenditures of the Geological Survey; by W. C. Kerr. 8 vo., 17 pp.

Pub. Doc. No. 32, Sess. 1876–'77, Gen. Assem. of N. C. Report of State Geologist concerning the Establishment of a Department of Agriculture, etc.; W. C. Kerr. 8 vo., 12 pp.

Physiographical Description of North Carolina; by W. C. Kerr. Raleigh, 1879 and 1882, 8 vo., 32 pp.

Minerals and Mineral Localities of North Carolina, being Chapter I of the Second Volume of the Geology of North Carolina; by F. A. Genth and W. C. Kerr. Raleigh, 1881, 8 vo., 122 pp. Five thousand copies published.

Map of North Carolina; by W. C. Kerr, State Geologist, assisted by Captain William Cain, C. E. New York, 1882. Scale, 10 miles to the inch.

Ores of North Carolina. Being Chapter II of the Second Volume of the Geology of North Carolina; W. C. Kerr and George B. Hanna. Raleigh, 1888, 8 vo., 237 pp. (123—359), and a mining and geological map of North Carolina. Three thousand copies published.

The following unfinished reports are in preparation:

Geology of North Carolina, Vol. II of Kerr's Reports, embodying the results of the survey from 1875 to 1885, in preparation under the direction of Professor J. A. Holmes; and a report on the Lithology of North Carolina, in preparation by Professor A. A. Julien.

PRODUCTS OF THE PINE.*
No. I.

TURPENTINE AND ROSIN.

W. B. PHILLIPS, PH. D.

Gentlemen of the Society:—It is designed in this paper to call the attention of the Society very briefly to some of the more salient features of the industry which, in the minds of most people, is associated with the name of North Carolina. In almost every text-book on the Geography and Resources of the United States the chief products of North Carolina are said to be Tar, Pitch and Turpentine, and, of late, Rosin, in spite of our 40,000,000 pounds of tobacco and 250,000 bales of cotton.

North Carolina is known as the great naval store State. Has not our chief city been built up mainly through its trade in the products of the pine tree? Is not the Cape Fear the most turpentiny stream that flows? Are we not ourselves true Tar Heels? But if we were called upon to give a definition of Tar, or Pitch, or Turpentine, or Rosin, I fear that many of us would return rather misty replies. It is very generally true that our knowledge of some of the most common articles of every-day life is extremely superficial. This arises not so much from objective as from subjective difficulties. The obstacles are esoteric. Familiarity, if it does not breed the usual contempt, does breed what is worse, a profound indifference

It is with the hope that this indifference may be somewhat disturbed, if not entirely removed for the time being, that I desire to speak to you this evening on Turpentine and Rosin, twin products of the Long-leaf Pine.

On the Atlantic coast, throughout a tract of land 600 miles long by 100 miles wide, beginning at Norfolk, Va., and ending

*A series of articles will follow on this subject.

in the southern part of Georgia, there grows a pine tree, known to botanists as the Pinus Australis, to ordinary people as the Long-leaf Pine. Its height is from 60—80 feet, its diameter 2 feet above the ground from 1 to 2½ feet. It has a thin bark, a cone from 6—8 inches long and from 4—6 inches across at the base, a wood with very little sap, and a leaf 10—18 inches long arranged in triplets in the sheath. A tree 60—70 feet in height has generally a diameter of 15—18 inches for 40 feet. This tree has also other names besides the two just quoted, as, for instance, with us it is sometimes called yellow pine, pitch pine and brown pine. Exported to the Northern States it is known as Southern pine and red pine; while in England and the West Indies it is termed Georgia pitch pine. For three-quarters of a century it has been the chief source whence the supplies of Turpentine and Rosin were drawn, and it will continue to be so for many years to come, as we have in this State alone more than five billion feet of merchantable Long-leaf pine standing. And as a dead tree can hardly be considered merchantable, we may feel satisfied that the supply will last for many years yet.

Our word turpentine is from the Latin *terebinthus*, meaning the terebinth, or turpentine tree. Mention is made of this turpentine tree in very early days, 2,000 years B. C., when Abraham first went into Canaan, *vid.* Gen., XII, 6: "Plain of Moreh" should be "grove of turpentine trees at Moreh."

While Rosin (more correctly Resin, which is the older word), at one time derived from the Greek word meaning to flow, is now compared with the Sanskrit rala (the resinous exudation from the Shorea Robusta, or the "Sāl" tree of Northwestern India). The resinous exudation from this tree is much like copaiva balsam, and a most costly camphor, Malay or Sumatra camphor, is obtained from it.

But what *is* Turpentine?

If I were to say that Turpentine is *not* Turpentine, perhaps I would be regarded as making a very foolish assertion. And yet it is even so. What we call Turpentine in common life is a very different thing from the Turpentine of commerce. In trade the

crude gum which exudes from the pine is called Turpentine, in common life one of the volatile products of the distillation of this gum is called Turpentine. In other words, in trade the *distillant* is Turpentine, in common life the *distillate* is Turpentine. What we call Turpentine is in the trade called "spirits," or spirits of Turpentine. In most text-books on chemistry mention is made of "oil of turpentine," a term not used in commerce, meaning spirits of Turpentine.

What is Rosin? Rosin is the residue left in the still after the extraction of the "spirits." It is strained, cooled by exposure to the air, and allowed to crystallize.

You will, therefore, please consider the term Turpentine as meaning the crude gum (before distillation); the term "spirits," or Spirits of Turpentine, as meaning the most important substance distilled off from this gum, and Rosin the residue left in the still, drawn off while hot, strained and crystallized.

There are three kinds of Turpentine, viz.: virgin, yellow-dip and scrape.

There are four kinds of spirits, viz.: white spirits and 1st, 2d and 3d "*shade*."

Of Rosin, excluding "opaque Rosins," there are fourteen different kinds, viz.: A., B., C., D., E., F., G., H., I., K., M., N., W. G. and W. W. Of these the highest grade is W. W. (water-white), beautifully clear and transparent, and almost colorless. Then W. G. (window-glass), also clear and transparent, but a shade darker in color than the W. W. Then N. Rosin, also clear and transparent, but a shade darker than W. G. And so on down to A., omitting L. and J., each letter signifying a Rosin of darker color, until when A. is reached the Rosin is black and allows no ray of light to pass through. And I may say just here that there are two main causes of the difference in color between Rosins: 1st. The quality of the Turpentine. 2d. The care bestowed upon the process of distillation. W. W. Rosin is almost colorless, A. Rosin is black, and between the two lie various shades of very light amber, a dark wine-color, and black.

There are two kinds of opaque Rosin, viz.: water-opaque, in which the opacity is due to admixed water, and spirit-opaque, or "Coachey" Rosin, in which the opacity is due to admixed "spirits." Both are whitish and non-transparent.

Let us now consider more in detail the Turpentine, or crude gum. Suppose we have a small forest of 10,000 trees, which have never been worked for Turpentine. The first thing to be done is to "box" them. The "box" is made on the side, preferably on the south side, of the tree from 4—6 inches above the ground, by cutting into the tree from above, sloping the cut across the grain of the wood, and then meeting this cut with another at an angle of 5°—10°. The chip taken off leaves a cut on the side of the tree, holding about two pints, and known as the "box." If the winter is mild and open this operation is begun during the month of December, and carried on through January, February, and into March. Ten thousand (10,000) trees constitute a "crop," and one man cuts the boxes. At the first approach of warm weather the Turpentine begins to exude from between the bark of the tree and the wood, runs down the incline and into the box, from which it is taken with wooden or iron scoops and put into barrels, preparatory to being carried to the still.

If the weather be favorable the trees will yield Turpentine for seven months the first year, beginning with April and ending with October. During that time about 18 inches of the bark of the tree are removed, so that at the end of the first year we have cut the box and removed 18 inches of bark. From 7 to 9 collections are made from each tree during the season, and as each box holds 2 pints, we get from 7 to 9 quarts per tree in a season. We have 10,000 trees, so that we should have at the end of the first year from 17,500 to 22,500 gallons of Turpentine, all of it "virgin," *i. e.*, of the very best quality. It is common to estimate the yield of 10,000 trees for the first year at 250—300 barrels of "virgin." The standard weight of a barrel of Turpentine is 280 pounds, which includes the weight of the barrel, but, in reality, these barrels seldom weigh so little as 280 pounds, ranging from 280—325 pounds. If we have selected the bushy top, thin

bark trees, growing in a sandy, dry soil; if we have cut our "boxes" properly, and attended them carefully, and had good weather, we should get 280 barrels of 300 pounds each of "virgin dip."

What shall we do with it? How can we obtain spirits of Turpentine and Rosin from it? By distilling it in a copper still. Formerly iron stills were used, but they imparted a reddish tinge to the spirits, so now copper stills are used, holding from 6—50 barrels of Turpentine, the ordinary size holding 15 barrels.

Turpentine may be regarded as a mixture of spirits of Turpentine, water and Rosin. The water, of course, boils at 100° C., the Rosin melts at 100°, and above 150° C. is gradually decomposed. The "spirits" boils at 158° C. Up to 100° C., then, very little will come over except water. Mixed with the water is a certain amount of pyroligneous acid, methyl alcohol, ether, and, perhaps, formic acid, which mixture is termed "low wine," and is frequently used by the laborers for kidney troubles. As the heat rises above 100° C. the "spirits" begins to come over, being yielded most abundantly, of course, at its boiling point, 158° C. The "spirits" accumulates on top of the low wine in the tub, and runs into a separate tub through a cock near the top of the first one. Of course in such a viscid mass as "virgin dip" it is only by long continued boiling, even at temperatures above 100° C., that the water is expelled, so that a good deal of water comes over with the "spirits," and the boiling is kept up until the proportion of spirits and water in an ordinary tumbler-full is 1 of spirits to 8 or 9 of water, *i. e.*, from $1\frac{1}{2}$—$2\frac{1}{2}$ hours. But where does all this water come from? It cannot all exist in the Turpentine, and, so far as known, it is not a decomposition product. It is added to the Turpentine in the still either at the beginning of the distillation or after it has been in progress for an hour. Its office appears to be to assist in the expulsion of the "spirits," by causing a more violent bubbling and boiling, with consequent vesiculation of the mass in the still. Operating with "virgin dip," *i. e.*, the yield of the first year, the distillation is stopped before all the "spirits" is driven off, so

that the Rosin may contain about 15 per cent. of the original content of spirits. At the proper time the cap of the still is removed, the liquid mass inside skimmed of trash, run out through a bottom cock, strained through wire and cotton batting and allowed to cool in the bins. The temperature of the Rosin as it comes from the still is 160° C. It cools very slowly, so that at the end of 4 hours, with an external temperature of 60°, it lost in one experiment only 60° F., and that after it had been ladled into barrels.

From fifteen 280-pound barrels of "virgin dip" there should be obtained not less than 105 gallons of "spirits" and 2,100 pounds of Rosin. A good working rule is to allow two-thirds of the weight of the Turpentine for Rosin and one-third for "spirits" and water. Ten thousand trees should yield the first year 280 barrels of "virgin," the second year 240 barrels of "yellow dip" and scrape, the third year 200 barrels of "yellow dip" and scrape. Or, in other words, for the yield of each year after the first year subtract one dipping of 40 barrels per year.

All that is collected from the trees the first year is called "virgin," and yields the best spirits and the finest Rosin. After the first year the turpentine is called yellow dip, and scrape, and yields inferior Rosin, and generally not so good spirits.

While, indeed, it is for the most part true that "virgin dip" yields the finest Rosin, yet it may yield the darker Rosins by too high a heat in the still. This has been denied, but the weight of evidence is clearly in its favor. In the endeavor to extract as much "spirits" as possible from the "virgin dip" and still leave the Rosin pale, it sometimes happens that the temperature of decomposition is reached and passed, and instead of a pale Rosin a darker one may come from the still. "Yellow dip" and scrape never yield pale Rosins. Whether this is due to chemical changes in the Turpentine before distillation, or to the action of foreign organic matter on the Turpentine during the distillation, or to the complete expulsion of the spirits, no definite answer can be made. It has been stated that about 15 per cent. of the original content of "spirits" is left in the Rosin from "virgin dip." This

is supposed to give to the pale Rosins their transparency and lack of color. But in distilling "yellow dip" and "scrape" no "spirits" is left in the Rosin. The effort to expel the spirits completely may cause too high a heat in the still, with consequent darkening of the Rosin.

Again, as "yellow dip" and scrape are exposed to the air longer than virgin dip, having to traverse oftentimes several feet of "face," oxidation products may arise, and influence the final color of the Rosin.

Again, there is always much more foreign matter mixed with yellow dip and scrape than with virgin, and the heat of 160° C. for an hour or two, in the presence of water, would doubtless extract from these pine leaves, bark and chips more or less of their coloring matter, which might well affect the color of the Rosin. The New York Standard Rosins are divided into 12 grades, viz., from the highest to the lowest:

W—	G—Low No. 1.
N—Extra pale.	F—Good No. 2.
M—Pale.	E—No. 2.
K—Low pale.	D—Good strained.
I—Good No. 1.	C—Strained.
H—No. 1.	B—Common strained.

These grades are used at Wilmington, Charleston and Savannah. But at Wilmington the arrangement, while essentially the same, has some minor points of difference.

Considerable experience is required before one can grade Rosin, and very few can do it without having the standards at hand, so as to compare constantly. After some time these "standards" acquire a lighter color, due to exposure to light, and this fact complicates the matter still farther. The higher grades of Rosin are worth from two to three times as much as the lower grades, and of course much interest has for years been manifested in the question of the possibility of bleaching the lower Rosins. Exposure to strong sunlight does raise the grade a degree or so in the course of several months, but this is not continuous. The main difficulty, I apprehend, is in our igno-

rance of what really constitutes the difference between the pale Rosin and the lower grades. I mean the chemical difference. Chemically, Turpentine is an oleo-resinous juice, consisting of resin and essential oil. The oil, or spirits, varying in amount from 15—30 per cent., consists, according to Flückiger and Hanbury (Pharmacographia, 1879, p. 606), "for the greater part of various hydrocarbons, corresponding to the formula $C_{10}H_{16}$," while Rosin, or colophony, as they term it, may be regarded as composed largely of the anhydride of abietic acid, and has the formula $C_{44}H_{62}O_4$ (*id.* p. 607). They do not state what Rosin it is that may be so regarded, but we will suppose that it is the best, or the clear, transparent, nearly colorless Rosin, say the W. W. As you will observe from these specimens of the various grades, there is a most marked difference between the W. W. and "E." or "D." Rosin. The fact I wish to impress upon you is, that we do not know what causes this great difference in color, whether it is due to oxidation, hydration, incipient decomposition, either or collectively. The authors above quoted (p. 607) go on to say that the living tree contains only the abietic acid anhydride; that on exposure to the air the Turpentine loses oil (or "spirits"), takes up water and solidifies as the crystalline acid of formula $C_{44}H_{64}O_5$. The presence of the oil (or spirits) in the turpentine determines the assumption of this molecule of water which changes the amorphous abietic acid anhydride into the crystalline abietic acid.

As before remarked, Turpentine is a mixture of "spirits" and Resin. But the "spirits" itself can and does undergo resinification, which is, perhaps, an oxidation, as formic acid is produced. But the resinification of "spirits" does not produce resin, which, as yet, has been shown to be identical with any natural resin. Therefore, we cannot say that resins are oxidized "spirits." A vast amount of chemical work must be done before one can say what is the chemical difference between the grades of Rosin. And yet, if the question of the conversion of the lower into the higher grades is ever settled on a firm basis, it will be settled by the practical chemist. *Quo difficilius, hoc præclare!*

PRODUCTS OF THE PINE.
No. II.

THE PRESERVATION OF WOOD WITH WOOD-CREOSOTE OIL.

J. H. MANNING.

In 1872, Mr. James D. Stanley, of Baltimore, Md., invented and patented certain retorts and arrangements for the production of "spirits of turpentine, oil, varnish and inflammable gas" by the distillation of pine wood. Wilmington offering the advantages of one of the largest naval store ports in the world, Messrs. Hansen & Smith of that city purchased in 1882 the patents and plant of Stanley for the purpose of more cheaply manufacturing these products and establishing a market for them. With certain improvements in the arrangement of retorts, they succeeded in manufacturing, but failed in securing a market for the oils. From this misfortune proceeded experiments with oil and the subsequent discovery of a process for using it in the preservation of wood. The antiseptic and preservative effects of creosote have long been known, and the effects of coal creosote in preserving timbers amply proved. By allowing lumber to soak in creosote oil and exposing the same, sufficient proof of its value was given, though the test in itself is insufficient, and better ways for impregnating the wood with oil were at once experimented upon.

Messrs. Hansen & Smith succeeded in perfecting machinery to this end, and until 1885 the process was carried out secretly on a small scale. This work was advertised and severest tests applied to their products. Not until 1885, when a stock company was formed, were patents issued for the process. This stock company, under the style of the Carolina Oil and Creosote Co., doing business in the city of Wilmington, has a capital stock

of $500,000. There is a factory working under the same patents in Fernandina, Florida, and one about to be erected in Seattle, W. T.

The site of the factory at Wilmington is about 1½ miles from Market street, on the south-western suburb, desirably located on the river. This plant has gradually increased from a valuation of $30,000, with a capacity of 3,000 feet of lumber per day, to the present valuation of $425,000, with a capacity of 40,000 feet per day. It consists of two parallel sheds for the protection of distilling retorts and a one-story building for reservoirs, pumps, boilers, creosoting cylinders, etc.

The most important preliminary step is the economic production of wood-creosote oil. For this purpose there are sixteen (16) retorts, arranged in batteries of two each for economy and convenience in firing, with a capacity of about 19,000 gallons creosote oil and the same amount of pyroligneous acid waste per month. These retorts are all similarly constructed, and hence a description of one will suffice for all.

A furnace substantially built of masonry, 26 feet long, 13 feet igh and 10 feet wide, supports in its beds two retorts. It is divided in the centre by a thin, fire-clay partition, so there are actually four different and complete furnaces. Each fire-place has its roof, in the inner ends of which are flues for the escape of the heat into the retort space. The retort rests horizontally in its bed and fits snugly into masonry, resting on loosely-fitting iron bands, allowing an air space entirely around the retort to the partition in the centre of the furnace, only interrupted by vertical semi-circular divisions, alternating from top to bottom, for the purpose of securing a uniform distribution of heat, and serving also in rapidly cooling the retort. This retort is a cast-iron, or, preferably, steel cylinder, 26 feet long by 6 feet in diameter, having a capacity of 4½ cords. Its ends are open, and may be closed by a perfectly-fitting cap with clamps, and by using asbestos or clay packing can be rendered air-tight. At the end of the retort a pipe 6 inches in diameter enters, and, gradually narrowing, conveys the gases to a copper worm through the con-

denser. This condenser alongside the furnace is a wooden vat 12 feet high and 10 feet in diameter, connected with the water-works, so as to secure a continuous flow of water, and contains a copper worm about 40 feet long, narrowing gradually to 1½-inch tube. On issuing from condenser this worm enlarges into a goose neck, or trap, in which the uncondensed gases and the liquid are separated. The gases are conveyed to another condenser and to the reservoir and are used for heating purposes. The liquid falls into a wooden vat of convenient shape and holding about 900 gallons, and connected by siphon and pump with reservoirs in the creosoting house. Each retort is a complete still, and a battery occupies a ground space of 26 feet by 26 feet. A retort, with ordinary care, should last 15 years. The working is simple. Good, resinous, fatty pine wood as having the highest content in oil is selected, and 4½ cords carefully laid in the retort, the ends sealed, and firing begun. The heat is gradually raised, driving off water, light gases and oils, until between 400° F. and 760° F. the heavy and most valuable oils distill. These are carefully condensed, not allowing the water in the vat to get more than lukewarm. The heating is kept up continuously for 26 hours, consuming about one cord of wood per battery, after which time the fires are removed and the retorts cooled as rapidly as possible. The charcoal, amounting to about 33 per cent. of charge, is raked out and meets with ready sale. The entire operation requires between 30 and 36 hours, with a yield of about 70 gallons creosote oil and 85 to 90 gallons pyroligneous acid waste per cord. The uncondensed gases being separated from liquid in the goose neck, are conveyed through another small condenser (recently added), wherein small quantities of oils are further condensed, passing over lime (unslacked), according to Stanley, and into reservoir, from which it is drawn and used for heating the retort. The distillate, upon standing (usually until the retort is charged again), separates into two liquids known as pyroligneous acid waste, consisting of water, pyroligneous acid, acetone, a small proportion of lightest oils and about 1 per cent. wood alcohol, and "creosote oils," consisting of 5 per cent. tar acids,

15 per cent. light oils and about 80 per cent. heavy oils. They may be completely separated with siphons and are pumped into their respective reservoirs. After longer standing, small quantities of oil separate from pyroligneous waste and are transferred to the oil tanks. The acid waste is sold to the Southern Chemical Co., and wood alcohol, crude pyroligneous acid and a black dye manufactured from it. It is also offered for sale as a cheap and reliable disinfectant.

The wood creosote oil is a very heavy black liquid, resisting the action of salt or fresh water, and is used principally in the preservation of wood, but patents have been issued for a mixture containing it for use as a "sheep dip," and it is recommended as an insecticide.

The creosoting plant consists in steel reservoirs, creosoting cylinders, pumps, etc. The steel reservoirs are constructed as the creosoting cylinders and are used for heating the oil preparatory to use. They are connected with the oil tank and creosoting cylinders, and contain a coil of steam piping connected with the boilers. The creosoting cylinders are made of steel guaranteed to stand 150—200 pounds pressure, and lie on a bed of masonry on a vel with ground. They are of varying length (from 60 to 100 feet long by 6 feet in diameter), having open ends with perfectly fitting caps. These caps can be rendered air-tight with asbestos packing. Into this cylinder runs a tramway with a movable section at the doorway. Under this track there is a coil of piping, usually about six times as long as the cylinder, connecting with the boilers. In the top, at intervals, are screws attached to semi-circular iron bands, used for holding the charge in position, and adjustable from the outside. At the end are the various pipes connecting with suction pumps, force pumps and oil tanks.

This company has in operation four of these cylinders, one 65 x 6, 90 x 6, 75 x 6, 100 x 6, with a capacity of 40,000 feet per day, costing from $800 to $1,200. No estimate can be had of their durability. Those now operated have been in use for several years and are apparently as good as new.

The process of creosoting is carried out according to this general plan. Good, "sap" or porous pine lumber, with or without previous charring, is run into the cylinder on a truck and made fast in position by the screws outside. The ends are then sealed perfectly and the temperature raised gradually by superheated steam to about 550° F., the suction pump is applied and as near a complete vacuum as possible produced and sustained for about 14 hours. This treatment serves to dry the wood thoroughly and expands its pores to the fullest extent, leaving them empty for the entrance of the fluid. The suction pump is disconnected then and sufficient oil to fill the cylinders run in. The force pump is next applied, with a pressure as high as 120 pounds per cubic foot, which is sustained until the desired amount of oil has been injected. This is very easily calculated by knowing the capacity of the cylinder less the charge of lumber and the cubic measure of lumber, and as much more oil over the amount necessary to fill cylinder as has been consumed represents the amount injected into wood. The oil stands at about 400° F., and the temperature of the cylinder is reduced to that degree. The oil being injected, the surplus is withdrawn to tanks, the lumber run out and is ready for shipment, the entire process usually requiring about 24 hours.

Many circumstances modify this general plan. It is by the condition of timber that the time of drying is determined—whether it is very green or seasoned; small planks or large timbers; and as to duration of creosoting, whether small planks or large timbers, very porous or compact, and to the amount of oil desired injected. Upon the careful manipulation of this process depends the success of its product, and every precaution is taken to insure it. The timbers may or may not be previously charred. Any quantity of oil from 3 to 20 pounds per cubic foot may be injected, and any size timbers handled from 1 to 20 inches in diameter and up to 100 feet long.

Previous charring is recommended as increasing the absorbing power by at least 50 per cent. Twelve pounds of oil per cubic foot is considered sufficient in all ordinary circumstances—more

or less being used according to the purposes for which lumber is to be used. Twelve pounds of oil per cubic foot increases the cost over crude timber about 100 per cent., with an additional 5 per cent. for each additional pound of oil per cubic foot. The advantages over other processes is in the economy and a more thorough impregnation of wood with creosote.

The superiority of wood preserved by wood creosote oil has been conceded by English and American contractors. Besides being an excellent mechanical packing, it is a reliable germicide and preservative, and its odor is exceedingly offensive to all insects, especially the teredo. It is supposed that sufficient quantities of tarry acids are present to coagulate the albumen of the wood, thus rendering fermentation less liable to occur. The heavy oils resist the action of water and cannot be washed from the pores of the wood. Creosoted wood can be used in any and all circumstances, and without material injury to carpenter's tools. It is several degrees harder than ordinary timber, and hardens as it gets older. It is recommended particularly for use as sills, cross-ties, piles, wharfs, spars, decks and in every place where the conditions are most favorable to the decay of crude timbers—where, in tide-water countries, the piles are subjected to alternate drying and wetting, in tropical countries, and wherever the ravages of insects are greatest. Large quantities of it were sold to the Panama Canal Co. It has been sold as high north as Novia Scotia, and south as far as Rio, and the severest tests applied, in none of which has it failed.

By the rapidly increasing demand for it among all classes of builders and contractors, we are assured that it is to be one of our largest and most important industries, and our Southern pines will have been increased greatly in value.

BOTANY AS A DISCIPLINARY STUDY.

GERALD McCARTHY, B. Sc.

Of all branches of natural science the study of plants, viewed merely as an instrument of mental discipline, offers the greatest inducements for the majority of pupils. During three-fourths of the year trees, shrubs and flowers are the most abundant objects in nature. They greet the eye on every side, and by their graceful forms, beautiful foliage and pleasant odors invite our attention. Since the maintenance of animal and human life depends upon the pre-existence of the vegetable world, plants appeal to the sympathies of even the most hardened admirer of pavements and gas-light.

Appealing in so many ways to human sympathies the study of plant-life is admirably fitted for awakening and stimulating the embryonic or dormant faculties of the mind. The facts with which this study stores the mind are interesting, useful and easily comprehended by even the very young, while riper and more disciplined minds will find therein unsolved problems worthy of the most extended reflection.

A few of the benefits conferred by a systematic study of plant-life may be here enumerated:

1. Plants are peculiarly adapted for cultivating in the student a love for form, symmetry and color—for stimulating the æsthetic faculties, faculties almost wholly and lamentably neglected in our common schools.

2. The study of plants trains the mind to habits of close observation and discriminating judgment, orderly arrangement and the "logic of systematization." All of these habits are of the very greatest utility to every human being.

3. The study of plant-life introduces the student to the study of the phenomena of life in its least complicated manifestations. The fundamental laws of organic life are the same in plants and

in animals, but in the case of animals and human beings the phenomena are so complex as to be quite beyond the power of comprehension of the beginner. The person who has studied the laws of nutrition, growth, reproduction, degeneration and extinction as exhibited in the vegetable kingdom will be well prepared to profit at a later period when he takes up the subject of animal and human physiology.

4. Plants can be studied far more thoroughly than is practicable with minerals and animals—in the case, at least, of young persons and those who have not at hand complex and costly apparatus and chemical re-agents often dangerous to handle. The lack of thoroughness in everything is the bane and scandal of our American schools, and the direct cause of the superficial character of so much of our literature, morality and laws. Concerning thoroughness in mental acquirements, Professor DeMorgan, of London University, gave the following advice to his students: "Whatever else you may do, some one subject you should thoroughly master for the purpose of giving the proper tone to the mind upon its regard to the use, province and limits of knowledge in general."

5. The study of plants furnishes an unequalled recreation and tonic for the mind subject to the strain of exacting business or professional life. Some of the most enthusiastic and accomplished botanists that this country has produced were practical and successful physicians, bankers, merchants and housewives. This study is especially valuable for invalids and persons of delicate physical organization and those of sedentary employment. When conducted in a rational manner the study is carried on principally in the health-giving atmosphere of the grove and meadow.

6. The study of plant-life, by exhibiting a practically inexhaustible field for research, acts as a preventive of the surfeit and disgust with the world which too often overwhelms highly but unsymmetrically developed minds. The wholesome restraint which the habitual exercise of the observing faculty—a faculty powerfully stimulated by this study—places upon the imagina-

tion serves to check its vagrant wanderings. There are no "cranks" in the ranks of botany! It guards also against misuse of the too often "fatal gift of expression," which so frequently makes its possessor mistake words for things and assertions for facts. An instructive example of what an exclusively literary and metaphysical training may do for a highly gifted man is seen in the career of the late Thomas Carlyle. Some time before his death Mr. Carlyle, in reviewing his life-work, made the following melancholy confession: "For many years it has been one of my most constant regrets that no school-master of mine had a knowledge of natural science so far, at least, as to have taught me the names of the flowers and grasses that grow by the wayside, and of the winged and wingless neighbors, who in my walks are constantly greeting me with salutations which, as things are, I cannot return."

It would be an easy matter to extend this enumeration as far as the orthodox thirteen, but these will suffice.

Perhaps some one will exclaim, "Yes, it is no doubt a pleasant thing to know by its proper name each wayside flower and tree, but who can remember the barbarous and uncouth names of botany?" Well, if one cannot at first remember the Latin names applied to plants by scientific botanists and unscientific pedants one can let scientific botany alone until one has developed some skill in observing plants and discriminating one species from another. The need of a terminology more exact than the common vernacular will become apparent and by that time the student will have developed enthusiasm sufficient to enable him to memorize the botanical vocabulary. At the beginning it will serve just as well to use the common vernacular name or even invent names for one's self. The name is the least important thing one can learn about a plant, and it is not wise for the beginner to exhaust his time and patience in trying to choose the most proper of several possible and equally unintelligible names. Rather he should study the structure and details of different plants and seek to group them around common types, thus learning for himself the philosophy of the natural system. The

scientific name must be eventually learned, but the unavoidable difficulty involved in learning and memorizing the name will be less discouraging when the need of knowing the name is urgently felt. Our barbarous Latin nomenclature, which well might make Virgil or Tully turn in their graves, is the least admirable part of the science and ought not to be obtrusively thrust before beginners! The average beginner is dismayed when, upon opening for the first time his botanical text-book, he finds the initial chapters headed by such unpromising words as Phylotoxis, Estivation, Morphology, etc., etc. This verbal quagmire placed by pedantry before the entrance to the "fairy-land of science" has swallowed up more budding scientific enthusiasm than has of war-like zeal

> "* * * that Serbonian bog
> 'Twixt Damiata and Mount Cassius old,
> Where armies whole have sunk."

Where the services of a competent teacher can be had the best way to begin the study of plants is to go into the field and study them upon their native soil. Where no such a teacher can be found—such teachers are scarce—recourse to books for guidance is inevitable. For young pupils, and older ones who are unfamiliar with Latin, the best book to begin with is Miss Youman's First Book in Botany. This will lead up to Gray's School and Field Book, but persons not likely to be discouraged by Latin words may begin with the latter book.

Much more useful than any book is the student's field outfit. This should include a good pocket magnifier having two lenses, a pocket-knife with a thin and sharp blade for slicing soft stems and ovaries, a couple of steel crochet needles for picking out small seeds, a garden trowel or a stout knife for digging up roots, and an air-tight tin box for preserving such specimens as may be wanted for further study at home.

It is not best to bother with drying plants for the formation of a herbarium until after the student has become well acquainted with all the species common to his locality. When that time comes he will want to procure new species for study, and these

can be best secured by exchanging with students in different parts of the country or of other countries. The names of persons willing to exchange specimens can be found in the Naturalist's Directory, published by Casino, Boston, or by inquiring of the botanist attached to any college or Experiment Station. The making of good specimens is an art that takes a deal of practice and care to learn, but the following directions will aid the beginner:

In collecting herbs not over three feet take the whole plant, root and branch. When taller than three feet cut off that much measuring from the top, and in addition dig up the root with such leaves as may be attached. Of shrubs and trees a twig with leaves and flowers will suffice, but a piece of the bark is often necessary to enable one to make out the species. For dryers use common straw wrapping paper in sheets 12 x 18 inches. Place wad, about one inch thick, between the layers of plants. Carefully spread out the leaves and see that the flowers are not covered by them before putting on the dryers. The dryers must be changed every twenty-four hours for the first three days, afterwards every two days until perfectly dry. For a press use lattice-work frames, which any one can make out of a few laths or narrow strips of board. Apply pressure by means of a stout cord or a trunk strap and keep the package in the sunshine or near a stove. The plants will dry out in about a week.

For more detailed instruction the student is referred to a little work, "The Plant Collector's Hand-book," by Professor W. W. Bailey, published by Cassino, price $1. A pamphlet equally as good is Professor L. F. Ward's "Suggestions to Beginners in Botany," which may be had gratis by applying to the Secretary of the Smithsonian Institution at Washington, D. C.

The following works for reference and general reading can be recommended, and they should be taken up in the order here given, viz.:

Gray's Manual of Botany of the Northern States.
Chapman's Southern Flora.
Local Catalogues of Plants.

Grant Allen's Colin Clouts Calendar.
Grant Allen's Pedigrees of Flowers.
Underwood's Ferns.
DeCandolle's Origins of Cultivated Plants.
Mehan's Wayside Flowers.
Goodale's Physiological Botany.
Sach's Lectures on Plant Physiology.
Darwin's Botanical Works.
LeMaout & DeCaisne's General Botany, English Edition.

The *Botanical Gazette*, a monthly magazine published at Crawfordsville, Indiana, will be found very interesting reading after the student has mastered the rudiments of the science.

RECORDS OF MEETINGS.

REPORT OF RECORDING SECRETARY.

FORTY-FIRST MEETING.

STATED MEETING. PERSON HALL, January 8, 1889.

Vice-President Graves presided. The following papers were read:

1. Report on Progress in Geology. Prof. Holmes gave an account of the efforts made at a unification of Symbols and Nomenclature.

2. Report on Progress in Physics and Engineering. In this Report Prof. Gore described the recent applications of Electricity to Street Railways.

3. An Historical Sketch of Mathematical Training in the University of North Carolina. This paper, by Prof. Love, besides containing a list of the instructors in mathematics and the text-books used during the century of the University's history just closing, outlined so far as possible the requirements for entrance and for graduation.

4. History of Mathematics in the Middle Ages. Prof. Graves continued, in this, his Early Mathematical History.

5. Early Legislation against Food Adulteration. Prof. Venable gave an account of some of the adulterations of food practiced in early times, the methods of testing for the same, and extracts from the old laws prohibiting and punishing such adulterations.

The Secretary exhibited the watch of Rev. Dr. Mitchell, which was worn by him when he met his death, and whose stopping was supposed to point to the exact hour of his fate. This watch has been presented to the Society by Rev. Mr. Summerell, the grandson of Dr. Mitchell.

The Secretary reported three additional exchanges and eighty-seven books and pamphlets received.

Messrs. A. H. Patterson and W. S. Roberson were received as associate members.

FORTY-SECOND MEETING.

STATED MEETING. PERSON HALL, February 12, 1889.

As the Vice-President was absent, Prof. Gore presided. The papers presented were as follows:

6. Preservation of Wood with Creosote Oil. This paper, by Mr. I. H. Manning, appears in full in this issue of the Journal.

7. Natural History of the Cereals. Gerald McCarthy, Esq., gave in this paper a short account of each of the principal Cereals, giving not only the natural history but the story of their introduction, in a brief form.

8. Some Sources for Sugar Proposed at the Close of Last Century. Mr. H. L. Harris showed in this paper that many vegetables and trees had been closely examined with a view to their sugar-producing power, thus anticipating much of the similar work done of late years.

9. An Account of an Interesting Fossil found in the Neighborhood of Chapel Hill. Prof. Holmes exhibited fragments of this fossil recently dug up in this vicinity and gave an account of its discovery. He hopes soon to present a more complete paper upon the subject.

10. Note on the Decomposition of Nickel and Cobalt.

Dr. Venable read to the Society an abstract of the important paper by Kruss & Schmidt on this subject.

The Secretary reported two new members:

Prof. W. H. Pegram, Trinity College, N. C.

J. R. Harris, Esq., Experiment Station, Raleigh, N. C.

Several additional exchanges were reported. Eighty-five books and pamphlets were received during the month.

FORTY-THIRD MEETING.

STATED MEETING. PERSON HALL, March 12, 1889.

Prof. Gore presided in the absence of Vice-President Graves.

The following papers were presented:

11. The Three Formations of the Atlantic Slope, with exhibition of photographs and specimens, by Professor Holmes.

12. A Note on the Use of Pulverized Coal as Fuel. By Prof. J. W. Gore.

13. A Photographic Camera made from a Cigar-Box, with an exhibition of views taken with it, by Mr. H. L. Harris.

14. Some Notes on Recent Progress in Chemistry. Dr. Venable described work done on preparing Artificial Quinine and Cocaine and gave some of the new applications of Cotton Seed Oil.

The Secretary reported as a new associate member Mr. C. W. Toms.

Twelve additional exchanges were announced and eighty-seven books and pamphlets received during the month.

FORTY-FOURTH MEETING.

STATED MEETING. PERSON HALL, April 2, 1889.

Prof. Holmes presided in the absence of Prof. Graves, the Resident Vice-President. The papers presented were as follows:

15. A Primitive Reaping Machine. Prof. Alexander gave an account of this machine described by Palladius, a Roman writer on Agriculture, as in use among the ancient Gauls.

16. The Consumption and Waste of the World's Resources. Dr. Venable called attention in this paper to the rapid consumption of the world's available supply of coal and petroleum, and of the great waste of many valuable metals.

17. Prof. Holmes gave a paper on the use of the microscope in Geology and Mineralogy, in which were described several forms of microscopes, and particularly the one recently manufactured for the University by the Bausch & Lomb Optical Company, of Rochester, N. Y.

The Secretary reported three additional exchanges and seventy-five books and pamphlets received.

FORTY-FIFTH MEETING.

ANNUAL MEETING. May 4, 1889.

In the absence of the Secretary and Treasurer, and because of the illness of the Vice-President, no reports were received from these officers.

The following officers were elected for the ensuing year:

President .....H. T. BAHNSON, M. D.....Salem.
Vice-President.....H. B. BATTLE, PH. D.....Raleigh.
Resident Vice-President.....J. A. HOLMES, B. SC.....Chapel Hill.
Corresponding Sec. and Treas......F. P. VENABLE, PH. D.....Chapel Hill.
Recording Sec. and Librarian.....J. W. GORE, C. AND M. E....Chapel Hill.